

Background material for presentation on Northern Fur Seal Foraging Project

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The [Alaska Ecosystems Program](#) is tasked with conducting research on the northern fur seal (*Callorhinus ursinus*) [Eastern Stock](#). The Eastern Stock consists of three Alaskan breeding sites: St. Paul and St. George Islands, which are part of the Pribilof Islands, and Bogoslof Island. The current status of the stock is designated as “depleted” under the Marine Mammal Protection Act and the population is about a third of its historical high of 2.1 million. The management goal is to recover the Eastern Stock to 60% of its carrying capacity which equates to doubling the current population size of 622,000 fur seals. Management of the species and research into the cause or causes of its decline rely on the 2007 [Conservation Plan for the Eastern Pacific Stock of Northern Fur Seal](#). The Northern Fur Seal Foraging Project’s main focus includes several research priorities detailed in the Conservation Plan and are listed below:

1. Compile and evaluate available habitat-use data
2. Compile and evaluate existing physical environmental data
3. Select appropriate environmental indices
4. Quantify environmental effects on behavior and productivity
5. Ecosystem modeling
6. Conduct oceanographic and fishery surveys based on pelagic fur seal habitat use

A key strategy has been to intensively analyze and publish on existing datasets, determine data gaps, and plan future research. With respect to the Northern Fur Seal Foraging Project, this includes analyzing satellite tracking data collected from 816 fur seals over a 23-year period to address items 1-4 listed above. Furthermore, analyses are designed to be integrated with the [Bering Sea Project](#) products, results, and [ecosystem models](#).

Status of ecosystem data (TOR 4)

Northern fur seal satellite tracking data are stored in a SQL server relational database, backed up each weekday evening, and an additional copy of the database is stored offsite. The tracking data used for peer reviewed publications are released to the public under the guidance of NOAA’s [plan](#) for Public Access to Research Results.

Strategies to obtain and manage ecosystem data (TOR 4)

Northern fur seal research has been ongoing since the late 1800s. Any historical research results, unpublished or published, that can be added to existing time series datasets are extremely valuable when considering potential fishery and climate change impacts on northern fur seal demography. Given the many intensive investigations on this species over the last 135 years, the AFSC has taken the strategy of “looking back to inform future hypotheses and study design.” Specific to the Northern Fur Seal Foraging Project, this includes the following:

1. Data rescue and use of Roger Gentry’s 19 year (1973-1992) northern fur seal behavioral research, Michael Goebel’s unpublished PhD thesis (1995-1996), and Jason Baker’s pup migration study (1996-1997).
2. Standardization and animal movement modeling of AFSC’s entire northern fur seal telemetry and diving database (816 seals) for spatial and temporal alignment with AFSC’s [Bering Sea](#)

[bottom trawl](#) and [midwater pollock surveys](#), [remotely sensed sea surface height](#) (AVISO), [St. Paul Island weather](#), [NCEP reanalysis 1](#) wind speed and direction, [NOAA's Large Marine Ecosystems](#) (LME), and the University of Washington's, Washington coast [Seaglider](#) survey line.

3. With respect to upcoming research during the summer of 2016, the results from above are helping to inform an AFSC cross-divisional research project utilizing autonomous vehicles ([Saildrone](#)) to sample biophysical properties of the ocean and walleye pollock prey fields in relation to fur seal foraging hotspots.

Integrated ecosystem-level analyses (TOR 5)

Integrated ecosystem-level analyses were reported in several papers including:

1. Migration, diet, and oceanography of adult females ([Ream et al. 2005](#))
2. Dispersal patterns of pups and climate ([Lea et al. 2009](#))
3. Subsurface thermal structure and the influence on fur seal dive behavior ([Kuhn et al. 2010](#))
4. Local depletion and foraging patterns of Bogoslof adult females ([Kuhn et al. 2014](#))
5. Adult male and female migration and the influence of thermoclines, storms, eddies, LMEs, and light ([Sterling et al. 2014](#))
6. Adult female migration in the California Current – foraging patterns explained by Seaglider observations ([Pelland et al. 2014](#))

Ongoing research efforts include: a) utilization of FEAST physical oceanography model output to help explain late season fur seal foraging behavior; b) potentially adding M.E. Goebels PhD thesis results on fur seal energetics and diet to the FEAST ecosystem energetics model; c) assessing the effects of Bering Sea basin eddies, storms, pollock stock structure, distribution and abundance on northern fur seal foraging and pup provisioning; and d) planning for the 2016 Saildrone/fur seal project.

Inclusion of ecosystem data into living marine resource management advice (TOR 6)

Results from our biennial pup production estimates are included in the [Ecosystem Considerations Report Card](#), while research results are annually communicated directly to managers at the Alaska Regional Office and at AFSC's northern fur seal demography workshop.

Peer-review ecosystem-related science program and products (TOR 7)

Approximately 85 northern fur seal publications since 2000.

Communication to managers, partners, stakeholders, and the public (TOR 8)

Research results are presented annually at the [Alaska Marine Science Symposium](#) and routinely presented at scientific conferences such as the [Biennial Conference on Marine Mammals](#), [Ocean Sciences](#), [Climate Impacts on Oceanic Top Predators](#), [Bio-logging](#), and the [International Congress for Conservation Biology](#). Communication to managers, partners, and stakeholders occurs annually at the Alaska Regional Office and in Seattle during AFSC's northern

fur seal demography workshop. Finally, AFSC has a formal partnership with the [Seattle Aquarium](#) where research results are communicated to the general public 1-2 times per year.